

THE IMPACT OF SPACE TO THE 21ST CENTURY AMERICAN MILITARY

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ABSTRACT

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The American military relies on outer space to enable all facets of operations. The reliance on space has a strategic impact on how the force is manned and equipped as well as a cultural impact on the expectations of the force. With a growing reliance on space as a medium to conduct operations, strategic leaders must look at the impact on the force and its ability to conduct operations if space is not available in the future.

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THE IMPACT OF SPACE TO THE 21ST CENTURY AMERICAN MILITARY

American Military's Use of Space

There is very little specific policy guidance on outer space. The United States is a signatory to the 1967 Outer Space Treaty. In essence, the 1967 treaty states that countries will not deploy weapons of mass destruction into space, and space is for the use of all mankind. The United States, United Kingdom and Russia were the originators of the treaty with ninety five other countries, including France and China, agreeing to the treaty over time.¹ In 2006, the Bush administration released a policy on outer space which consisted of seven main principles. Included in the principles were statements that the “United States considers space capabilities—including ground and space segments and supporting links—vital to its national interests” and that “the United States will oppose the development of new legal regimes or restrictions that seek to prohibit or limit U.S. access to or use of space”.² Additionally, the policy contained language similar to the Outer Space Treaty, implying space should be used for peaceful purposes. Many countries, including the United States, tend to interpret the “peaceful purposes” language in the treaty as they see fit.

In January 2007, the Chinese government carried out a successful anti-satellite weapons test against an aging weather satellite.³ Although the anti-satellite capability is not a new technology, this demonstration should serve as a wake up call for the United States and other nations that space may not always be available as a medium to conduct operations.

Today, the American military and much of society is fully integrated into space based systems. The military utilizes the Global Positioning System (GPS) for all facets

of operations, from navigation for its land and space based forces to precise guidance for some of its advanced weapon systems. Additionally, the technology and systems that allow people around the world to view a live television broadcast also enables the American military to fly and operate Unmanned Aerial Vehicles (UAVs) in Afghanistan from ground stations located in the Continental United States (CONUS). This integration goes beyond peripheral capabilities and information. Command and control centers, such as Air Operation Centers (AOCs), now rely on information utilizing space based systems to receive information and command forces. This enhanced technology and real time information capability changes the way the American military trains, equips, and employs forces. Now, Rules of Engagement (ROE) and real time command and control decisions are driven by connectivity between forces and command and control elements, such as the AOC. In turn, the AOC is reliant on direct links from Intelligence, Surveillance, and Reconnaissance (ISR) assets which provide time sensitive information. These relationships currently rely on leveraging space based systems.

First, this paper will examine how the military's reliance goes beyond merely utilizing systems; reliance on space is now incorporated into many facets of American military culture and the nature of being an American military professional. Next, this paper will explore paths the US government may pursue in order to ensure access to capabilities currently enabled through space.

American Military Culture and Professionalism

The culture and professional expectations of the military evolved with the advancement of space technology. Many capabilities which may have required boots on the ground in previous conflicts are now accomplished remotely or with a much smaller forward deployed footprint. The American military refers to this capability as "reach

back”. Similarly, with the advent of the GPS, the military now is capable of and expected to provide a level of precision which was untenable a decade ago. In both situations, many of the original methods used prior to space based systems atrophied to the point where they are no longer viable alternatives. Additionally, as a new way of conducting operations evolves, the old method may no longer be deemed acceptable by the American military or its constituents. The acceptability of military practices impacts the professional status of the American military. At one time simple compliance with the Laws of Armed Conflict (LOAC) may have been a barometer for acceptability for the professional status of the American military; today the demands are much higher. Space technology directly influences American military culture and places new demands on its professional status.

The loss of access to space to conduct operations would impact the culture of the American military and create potential ethical and professional dilemmas. The United States military relies on GPS and would experience adverse cultural and ethical effects without it. The American military also relies on communication satellites to enable UAV operations and would experience adverse cultural, ethical, and professional effects if it is unable to leverage these satellites in the future.

Since the late 1990s the United States military has grown to rely on GPS as a navigational system which in turn provides a level of precision that has become a norm across the spectrum of military operations. Ground troops deploy with GPS enabled Blue Force tracking systems, providing precise location information which decreases the chances of fratricide. Additionally, airborne assets utilize GPS for aircraft navigation and to enable guidance systems on the majority of the precision weapons in the

inventory. The precision enabled by GPS has become a necessity versus a nicety in many facets of warfare, to the point where it has become a part of American military culture.

Precision location and tracking also has become a part of military culture for American ground troops who are now reliant on GPS as part of daily operations. First, GPS enables troops in the field to pinpoint their exact location. This capability helps to mitigate confusion, or fog of war, that could otherwise result. Anyone who has used a map and compass for navigation understands the uncertainty with this method as individuals struggle to evaluate which ridge they are on or which mountain lays in the distance. GPS mitigates the problem by providing a current location within twenty meters⁴ for the most basic of systems along with providing a heading and distance to any location entered in by the user. Next, GPS enables advanced systems such as Blue Force Tracker. “Blue Force Tracker allows the military to track, through a GPS, location and movement of US vehicles as well as other ‘friendly forces’. This system also highlights significant activities like IED strikes, mortar attacks, and troop movements.”⁵ Finally, GPS enables troops in the field to locate and target enemy forces with unparalleled precision. The GPS enables ground and airborne sensors to derive target coordinates with a high level of confidence. American forces derive the coordinates using GPS and some surface to surface systems now employ GPS guidance systems. As an example, in 2007 the Army tested GPS guided artillery, demonstrating a ten meter circular error probable (CEP) for artillery fired from a distance of twenty four kilometers.⁶ The use of GPS has also become a part of the culture for airborne assets as well as ground forces.

United States military aircraft utilize GPS for all facets of day to day operations. GPS provides a navigational reference for onboard inertial navigational devices. Similar to the situation with ground forces, this constant location precision reduces the fog of war by enabling the crew of the aircraft to have precise location data at all times. Subsequently, GPS has become the mainstay for United States airborne weapons, providing a precision that didn't exist ten years ago. All strike aircraft in the US inventory now employ the Joint Direct Attack Munition (JDAM). The JDAM enables a consistent accuracy of ten meters or less for a launch and leave weapon that can be dropped in all weather conditions.⁷ The increased precision has changed the culture and ethics of the United States military.

Increased precision capabilities are now part of military culture where it is expected that American forces should not only be able to derive their own location but strike enemy locations with ten meter accuracy. Consequently, this capability changes the ethical environment for the military because the ability to hit the target and minimize collateral damage is now the expectation not the exception. Protocol I of the Geneva Convention calls upon countries not to cause more damage or loss of life than is necessary.⁸ Because American forces are expected to be able to target exact locations, they draw extreme scrutiny whenever there is collateral damage and precision weapons are not used.⁹ The ethical expectation now is that American forces can attack enemy targets while minimizing or completely negating collateral damage. The GPS enables the precision capability of most current American weapon systems and its loss will not change the current expectations.

In most forums, American military personnel are considered professionals. “The factors that mark an occupation as a profession are expertise, jurisdiction, and legitimacy.”¹⁰ GPS contributes to the expertise and legitimacy portions of the definition by enabling American forces to reduce the fog of war for friendly forces, target enemy forces with precision, and minimize collateral damage to lower and lower levels. A boundary for legitimacy in the legal realm is the laws of armed conflict (LOAC). Military personnel are not allowed to violate LOAC regardless of who gives the order. With that said, there are situations where an airman could abide by LOAC but various groups across the world may deem those actions as outside the boundaries of the military. As an example, it may be legal to bomb a mosque under certain situations based on LOAC but many will see that act as wrong regardless of the situation. This creates a predicament where many may view the military actions as illegitimate and therefore the entire military operation may be at risk. To some extent legitimacy is in the eye of the beholder and the support of the American people as well as the world may hinge on the world’s perception of military actions. The military is expected to have the expertise to obviate collateral damage with facilities such as mosques and hospitals. Space systems enable this expertise which is pivotal to the legitimacy of overall American operations. These expectations are exacerbated in the multimedia world of today. “Undesired effects play an increasingly critical role in war planning. Desert Storm analysts coined the phrase ‘CNN effect’ to describe the sometimes disproportionate degree of attention given to undesired or unexpected effects.”¹¹ Standards of precision and minimal collateral damage have been established by the American military and its citizens. Much of this capability is enabled by GPS technology and the loss or degradation of this

capability for one reason or another should not be expected to change the professional standards expected of the United States military.

One of the great enablers for many new technologies, such as GPS, has been the ability to relay information long distances via communication satellites. The United States military leverages these satellites to monitor sensors and even conduct flight operations from rear echelon bases. The United States military has shifted to a culture where many operations in war zones can be controlled from stateside bases. UAV operations have become extremely reliant on reach back using communication satellites as a conduit for these types of operations.

The United States military's increased reliance on reach back to operate UAVs has led to a change in the expeditionary culture of some units. To begin with, many UAVs are launched from forward bases but all sensor and flight operations, besides takeoff and landing, are controlled from bases within the United States. As an example, the concept of operations for the US Navy's new Broad Area Maritime Surveillance (BAMS) system will have all ground stations located in the United States rather than deployed overseas.¹² Additionally, the majority of the individuals who analyze the sensor data are also able to do so from stateside locations. This capability has strategic implications because it reduces the number of people and the amount of equipment that must deploy forward to conduct operations and has the second order effect of creating sub-cultures within the UAV community who become less and less deployable over time, simply because they are not required to do so. Although the United States military may be more effective in terms of logistics, its expeditionary capability for UAVs is in jeopardy if the reach back technologies become unavailable in the future.

A loss of expeditionary capability for UAV personnel could lead to future ethical and professional dilemmas for the United States military. In some theaters of operation UAVs are a critical piece of the ISR mission. To further aggravate the situation, the requirement for this mission will continue to increase in the future as the United States military deploys more and more network centric type systems.¹³ If the military is denied access to communication satellites then the ability to control UAVs and their sensors from stateside bases would disappear. Without a deployable and expeditionary culture within the UAV community, critical network centric systems would not provide needed information to the war fighter. The inability to operate UAVs would create a serious challenge to the military's professionalism in terms of expertise and legitimacy. The United States military is expected to leverage the state of the art resources to reduce the fog of war and effectively target the enemy. Lack of critical ISR capability may lead to the ethical dilemma of having to make life and death decisions without all of the normally required information. Obviously, this is not a situation American decision makers want to be in.

Ensuring Access to Current Space Enabled Capabilities

A primary objective of the United States military should be to ensure access to the communication, precision, and information capabilities required to conduct operations. Currently, much of this capability either resides in space or relies on space based enablers. The United States needs to take measures to ensure it has access to these space capabilities or develop redundant systems to provide the same capability. The goal is to prevent American space based systems from being potential single-point failures for future operations. Two paths to explore are to increase access to space assets or develop alternative means to accomplish these missions.

In pursuing an option to increase access to space, two potential paths are for the American government to buy more satellites or partner with commercial entities to secure increased access. The United States could develop and deploy redundant satellite systems for use and or deployment when the situation required. In essence these satellites would serve as spares. In partnering with commercial entities, the government could enter into leasing arrangements, to secure additional bandwidth in areas where it doesn't currently have a requirement. Both paths have their advantages and disadvantages.

Procuring spare satellites is very costly in terms of alternatives but there are situations where this makes sense. In the case of GPS, the United States has redundant satellites in orbit as well as satellites which are assembled and ready to deploy. This situation is somewhat unique due to the constellation requirement of GPS to have four satellites within the field of view in order to provide location and time references to the receiver. Three satellites are needed for accurate location information and the fourth satellite allows the receiver unit to compute time. Additionally, GPS is a tremendous growth industry in both the civilian and military sectors which requires new satellites periodically in order to introduce new capabilities. In March of 2009, the United States government launched its most recent GPS satellite, GPS IIR-M system, which provides additional military and civilian signals along with increased signal strength.¹⁴ As new satellites are placed into orbit, the older satellites remain and provide redundancy to the overall constellation, which requires twenty four satellites for full capability. As an example, in 2005 the US launched the first of the IIR-M satellites,

making a total of twenty eight satellites in orbit at that time with three additional launches planned for 2006.¹⁵

In the GPS example, the spare satellite concept works out for the reasons listed above and because of the location of the orbit. GPS satellites are in a low earth orbit, 1200 miles above the earth's surface, as compared to traditional communication satellites which are normally in a geosynchronous orbit, 22,000 miles above the earth's surface. It is much easier and less expensive to place a satellite into low earth orbit compared to geosynchronous orbit.

Similar to the GPS development, the commercial satellite industry is also a growth industry both within the Department of Defense (DOD) and the civilian sector, particularly for communications. In recent conflicts, the DOD partnered with the civilian sector to lease bandwidth on commercial communication satellites, enabling operations in austere locations such as Iraq and Afghanistan.¹⁶

The United States pursued a variety of procurement and leasing strategies for communication satellites in the 21st century, but the trend appears to be towards the latter of the two choices. One of the main thrusts of DOD's procurement strategy was the \$26 billion Transformational Satellite Communication System (TSAT). The TSAT was to consist of five satellites which would enable secure communications between network centric systems with a high tech focus on ISR type information.¹⁷ In 2006, this system was one of the military's main efforts, if not the main effort, to secure more military satellite options¹⁸. In 2008, it appeared that TSAT had demonstrated satisfactory technology development according to Art Gallegos, Assistant Government Accounting Office Director.¹⁹ However by April 2009 the program was dead, killed by Secretary of

Defense Gates in favor of “technologies that will have an immediate impact on U.S. forces in southwestern Asia.”²⁰ This was a program that was under development for several years with more than two and a half billion dollars already invested in the effort. It undoubtedly fell victim to competing priorities in an environment where the extreme cost of doing business in space coupled with the costs of advanced technology made it untenable in the minds of DOD leaders. Ideally, the American military would prefer to have its own dedicated satellites for reasons of security and access; however, as seen in this example, the cost and time required to develop and field advanced satellite systems may also prove impossible depending upon competing demands for DOD money between various programs and efforts. In this example getting the original system funded proved to be futile, much less the concept of a spare. This situation forces a further reliance on the civilian and private sector which pose various dilemmas.

The United States and many governments around the world lease bandwidth on commercial communications satellites. According to some estimates, the American military relied on commercial satellites for 80% of its communication capability in Iraq in 2006.²¹ Many times these leases require commitments and cooperation from and between non American held organizations and corporations. As an example, TS2 Satellite Technologies claims to have been one of the first telecommunication providers to US forces in Iraq and Afghanistan.²² In order to provide telecommunication services to the American military in the region, TS2 Satellite Technologies entered into agreements with Intelsat and Arabsat.²³ In this case, one of the companies is held by an American corporation and the other is not. Even if the company is owned by an American corporation, which Intelsat is, it still may rely on foreign support and services.

A case in point is Intelsat's most recent satellite was launched from Kazakhstan in November, 2009.²⁴ In the case of Arabsat, it is already a foreign held company but it has several ties to other foreign companies as well. Arabsat was founded by the Arab league²⁵ and partners with CETel Germany and Globecast, a subsidiary of French Telecom.²⁶ The cooperation required in this example demonstrates the influence of globalization on the space and telecommunications communities and provides and validates that it may not be possible for the American military to simply leverage American companies and systems to support efforts. TS2 Satellite Technologies most likely partnered with Arabsat because it was the entity with the most assets in the region. This potential conundrum raises questions on security and access along with acceptability in terms of war being directly enabled by civilian entities.

The DOD must address the acceptability of its reliance on commercial or foreign space assets to enable military operations. According to the Outer Space Treaty, space is intended for peaceful pursuits. Despite the verbiage in the Outer Space Treaty, former President Bush's 2006 Space Policy included what can be perceived as a disclaimer when he stated, "The United States is committed to the exploration and use of outer space by all nations for the peaceful purposes, and for the benefit of all humanity. Consistent with this principle, 'peaceful purposes' allow U.S. defense and intelligence related activities in pursuit of national interests."²⁷ Although President Bush clarified American intent to utilize space for military purposes, the legal grounds for using civilian assets to enable military operations is nebulous despite DOD's track record of leasing bandwidth from commercial entities to enable combat operations. This situation is exacerbated when foreign governments or foreign companies own part of

the telecommunications companies involved. Any use of those assets in a combat scenario would appear to at least make the assets legal targets which would then thrust the satellite owners into the conflict as well. In Afghanistan and Iraq there is not a sovereign enemy to contest the leasing practices of the United States. In another arena, the potential exists for the United States and a competitor to lease bandwidth off of the same satellite or for one country to lease satellite time with the sole intention of denying this capability to another country. There are numerous permutations to this scenario.

Increase Non-Space Based Technology

Increasing the number of systems in space or access to systems already in space does not ensure access to communication, precision, and information capabilities the American military requires, especially in a hostile environment. Due to the exorbitant cost of operating in space, many adversaries will seek more cost effective ways to counter space based technologies and efforts. Various types of low technology systems are prevalent throughout the world today and focus on a user's ground-based receiving system as opposed to its satellites. GPS jammers are an example; they deny the use of the GPS signal to the operator as opposed to attacking the satellite element.

Additionally, advanced non-spaced based technology may provide more cost effective ways for ensuring access to communication, precision, and information capabilities by augmenting or replacing spaced based methods. The United States military currently pursues technology advancements which ameliorate the reliance of space as a medium for operations. Two examples of areas which utilize these advanced technologies are precision GPS weapons and UAVs. The following paragraphs will provide examples on how non-space based technology augments current space capabilities in these two fields.

American military aircraft and weapons have several features to counter the effects of GPS jamming. First, most GPS enabled military aircraft and weapons contain Inertial Navigation Systems (INSs) which provide a great degree of precision. Although these INSs do drift, the drift rates are predictable and overall they provide very accurate location and velocity information to the aircraft and weapons. These weapons systems normally use GPS to update the location and velocity information of the INS. Many aircraft also have the capability to update the INS autonomously without inputs from the GPS but provide less accuracy than GPS when done in this manner. The advertised accuracy for a JDAM is a CEP of thirteen meters for a GPS/INS-aided weapon and thirty meters for an INS-only with no GPS or a GPS that is unreliable due to jamming or other factors.²⁸ More advanced guided weapons systems, such as the Joint Air to Surface Standoff Missile (JASSM), also employ separate anti-jam GPS antennas as well as terminal guidance systems to increase precision while negating the effects of GPS jamming.²⁹ These weapons use GPS/INS navigation to get the weapon close to the target and then the terminal guidance mechanism takes over to ensure a precision strike. Many military aircraft and some of the advanced weapons, such as JASSM, use jam resistant GPS antennas to negate many of the effects of GPS jamming.

Another major growth area within the American military is that of UAVs. UAVs provide several advantages to the American war fighter, as mentioned earlier in this paper, but they come at a cost in terms of required bandwidth to control the UAV and transmit information to and from the sensors on the UAV. The BAMS UAV program leverages technology in two ways which reduce required bandwidth support from communication satellites. The UAV will fly preplanned missions overseas and relay

imagery, utilizing a satellite downlink in theater, which is then sent to the United States using a landline.³⁰ The use of landlines to relay information to analysts in the CONUS saves considerable bandwidth and dependence on communications satellites.

Furthermore, flying a pre-planned mission eliminates the need for continuous dedicated bandwidth for a pilot to provide flight control updates. Although the BAMS concept does not totally negate the need for communication satellites, it does reduce the current requirement for bandwidth and provides an example where leveraging technology can alleviate strain on the communication satellites while enhancing the chance of mission success.

Analysis and Recommendations

Ultimately many American decisions which transpire during procurement and development processes come down to tradeoffs between effectiveness and efficiency, with cost and risk acceptance as two areas to consider. As outlined in this paper, other factors the American government must consider in the 21st century are culture, redundancy, and acceptability.

In assessing choices during procurement or leasing processes, the American Government must obviate situations which put the American military's professionalism, in terms of expertise and legitimacy, at risk. To begin with, although the American military was able to function without much of the technology that enables precision, information, and communications flow in the past, this came at a price, many times in terms of casualties or collateral damage. Subsequently, the development of weapons such as JDAM and JASSM changed the expectations of the American military by raising the expectation of precision and correspondingly, decreasing the acceptance of collateral damage. These expectations are now norms for American military

professionals and failure to meet these expectations may place the legitimacy of a given American effort at risk.

GPS and communication satellites afford the United States tremendous technological and efficiency advantages that have become the standard and the expectation of the military as a profession. According to Army Field Manual 1, “professions create their own standards of performance and codes of ethics to maintain their effectiveness.”³¹ There is no question that a professional organization is expected to leverage technology. The military must strike a balance when leveraging technology to avoid over reliance in an arena that may be held at risk in the future. The United States military should develop redundant systems and train with those systems to obviate situations where the loss of a capability or medium, such as access to space, reduces the military to the point where it can no longer function with the expertise, ethics, and therefore the legitimacy expected of it as a profession.

Alternatives to space enhanced systems do not necessarily require significant technology leaps. In making technology choices, advanced INSs which drift less, anti-jam GPS antennas, and terminal guidance mechanisms are examples of how the American military could leverage current technology to augment or replace a space based navigation system such as GPS. Obviously, these choices add to the procurement costs of weapons and weapon systems but the American military should consider these types of alternatives when making procurement decisions.

Although the technological advancements mentioned in this paper have enhanced the status of the military profession, future advancements don't automatically ensure the same result. The US government's primary goal in developing GPS aided

weapons was increased accuracy and not the reduction of collateral damage or the positive impact on the professional status of the American military. First and foremost, precision was required to increase weapons effects. In the future, as these or new weapons are refined or developed, the American government should consider whether these technological changes jeopardize the culture or professional status of the military in jeopardy. As an example, as GPS technology matures it may become possible to reduce the cost of a JDAM by removing the INS and strictly relying on GPS guidance, resulting in the space-based GPS becoming a potential single source of failure. Along parallel lines, as INS technology evolves it may become feasible to put an INS in a JASSM which is sufficient to guide it to the target without GPS updates. The JASSM option may add cost to the weapon but provide a technology alternative to GPS. The resulting question then becomes, will DOD leave the redundant GPS in the weapon system at that point or remove it? The JDAM example would undoubtedly save money but create a reliance on GPS as a single point of failure if it doesn't work or is unavailable. In both of these situations, there are potential technology decisions which could eliminate or provide redundancy to the respective weapons. The US government should avoid making financial decisions that eliminate redundancy and negatively impact military professionalism.

The American military's reliance on the civilian sector coupled with the advance of globalization may present legal issues in terms of acceptability during the 21st century. As illustrated in the communications satellite example, it may not be possible to leverage strictly military or even strictly American civil assets in this growing area. The legitimacy of conducting or enabling military operations with non military personnel and

systems raises questions regarding LOAC. According to LOAC, noncombatants are individuals who are not authorized by governmental authority to engage in hostilities.³² Civilian satellite systems supporting military operations could create a potential dilemma in regards to their combatant status. Furthermore, one of the main principles of LOAC is that of distinction. "The central idea of distinction is to only engage valid, military targets."³³ By leasing bandwidth from commercial satellites for military purposes, those satellites directly enable military operations and one could argue that they would then become valid targets based on the principle of distinction. Along those same lines, the launching pad in a non aligned country for the conflict could also be considered a valid target if it was scheduled to launch a system that is planned to enable military operations. Although globalization lends itself to industries crossing national boundaries, this is problematic in the conduct of warfare and not something the United States can assume will be acceptable or even an option for future conflicts. The United States must develop systems which do not rely on the civilian sector in the transnational world of the 21st century.

Conclusion

The American military should continue to enhance precision, information and communication capabilities in the 21st century by leveraging technology and space. In doing so, the military must take into account the need for redundancy that solidifies the status of the American military as a professional force and does not allow for risk in the area of professionalism as defined in terms of expertise, legitimacy, and jurisdiction. By partnering with civilian industry, the military is able to enjoy efficiencies in the financial arena, but potentially complicates its position in terms of legitimacy by incorporating

civilian assets into the military realm. This situation is exacerbated in the 21st century with the emergence and rise of transnational corporations in space related fields.

Endnotes

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